Richmond Refinery LPS Bulletin – Reliability

NHT Shutdown to Skim R-410 Catalyst

Impact ERM:
Loss # 31452
Investigation # 19759

Location: D&R ABU, No.5 Naphtha Hydrotreater (NHT)

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R-410 Crust Photos:

Particles collected May 2012.

Particles collected February 2011.

URIP – Unit Reliability Improvement Program

Incident Description:

On May 13, 2012, the NHT plant was shut down for 5 days to address the R-410 reactor high pressure drop (dP). Over several months, the dP increased across R-410 requiring "crust-buster" chemical injection to sustain unit throughput, but was not an effective long term mitigation. The D&R ABU decided to pursue an unplanned reactor catalyst skim.

R-410 was last skimmed in Feb 2011 resulting in a sub-optimal one-year catalyst run. Since the last skim, the dP started to gradually rebuild, but upon startup after the 4Q 2011 D&R major turnaround, the dP started to build more quickly than previously.

Multiple foulants (mainly iron sulfide, but also sodium, coke, and diolefins) settled on top of the first R-410 catalyst bed, leading to the rapid dP increase in 2011 and 2012.

Investigation Findings:

1) Iron sulfide scale from the equipment upstream of R-410 accumulated on the catalyst.
2) Scale from the cold feed system plugged the V-420 coalescer and passed by to the R-410 reactor.
3) Following the D&R major turnaround, flushing the TKC wild naphtha line to the NHT sent more scale to the R-410 reactor.
4) Heavy end point material and material with diolefins (which form gums) was routed to the NHT cold feed tank due to improper off-test GHT, FCC and TKN/TKC routings.
5) Residual caustic from a previous NHT dP excursion contributed to further plugging.

What Worked Well:

1) "Crust-buster" chemical injection extended the NHT catalyst run.

Recommendations:

1) Install two six-inch layers of Catalyst Trap material to trap scale without increasing the dP.
2) Establish PMs for routine element replacements at V-420, and install a filter ahead of V-420 to remove scale upstream.
3) Determine a better process to flush wild naphtha and off-test GHT and FCC material than NHT.
4) While skimming the catalyst, remove excess scale from reactor walls.

Tenets of Operations Violated:

10. Always involve the right people in decisions that affect procedures and equipment.